



Environment, Health & Safety Division

March 22, 2001
DIR-01-070

Mr. Bernd Franke
Institute for Energy and Environmental Research
Wilckensstr. 3
69120 Heidelberg, Germany

Dr. Owen Hoffman
SENES Oak Ridge, Inc.
102 Donner Drive
Oak Ridge, TN 37830

Gentlemen,

Berkeley Lab has reviewed the draft final report prepared by the Institute for Energy and Environmental Research (IFEU) titled Review of Radiological Monitoring at LBNL (February 2, 2001). We appreciate the care and thoroughness with which IFEU reviewed and commented on our radiological monitoring program. While we might disagree with some of IFEU's conclusions, we respect the objectives of their review.

We submit the enclosed comments on the IFEU draft Final Report. Also, enclosed is a copy of the Berkeley Lab comments previously provided on the IFEU Preliminary Technical Report (June 30, 2000). Berkeley Lab appreciates that the authors invited comments that would be incorporated into the final report.

We look forward to working with Mr. Franke and Mr. Greenhouse as they complete their review of radiological monitoring at Berkeley Lab. If you have any questions on this matter, please contact Ron Pauer at (510) 486-7614.

Sincerely,

David McGraw
Director
Environment, Health and Safety Division

Berkeley Lab Response to IFEU Report

cc:

N. Al-Hadithy (City of Berkeley)

K. Berkner

R. Kolb

D. Nolan (DOE)

M. Schoonover

R. Pauer

Enc: Comments on the IFEU draft Final Report

Copy of Berkeley Lab comments on the IFEU Preliminary Technical Report (June 30, 2000)

Berkeley Lab Review Comments on the IFEU Draft Final Report

Berkeley Lab has reviewed the IFEU draft final report titled *Review of Radiological Monitoring at LBNL*, dated February 2, 2001 and provides comments on 12 IFEU items of concern. Berkeley Lab provides comments on eight of those IFEU items in this document. On the remaining four items, Berkeley Lab references comments previously provided to IFEU on the initial draft report dated June 30, 2000 (see attached *Berkeley Lab Review Comments on the IFEU Preliminary Technical Report, September 5, 2000*). Table 1 indicates where each Berkeley Lab comment is provided.

Table 1. Overview of Berkeley Lab Comments on the IFEU draft Final Report

IFEU Item of Concern	Location of Berkeley Lab's Response
A.1 Is the tritium inventory at NTLF adequately determined	Comment provided below.
A.2 Are the releases of airborne tritium adequately monitored?	See attached Berkeley Lab comments 6, 11 and 12 provided to IFEU on September 5, 2000.
A.3 Is tritium in air measured at the right locations?	Comment provided below.
A.4 Is the sampling and analysis of tritium in air at a given location sufficiently accurate?	See attached Berkeley Lab comments 11,12 and 13 provided to IFEU on September 5, 2000.
A.5 Are radiation exposures to individuals from NTLF operations below 10 mrem per year?	See attached Berkeley Lab comment 6 provided to IFEU on September 5, 2000.
A.6 How relevant is the presence of organically bound tritium?	Comment provided below.
B.1 Is LBNL's Draft Tritium Sampling and Analysis Plan sufficient to determine the extent and nature of legacy contamination at NTLF?	Comment provided below.
B.2 Which other factors need to be addressed in EPA's evaluation of the Superfund status for the NTLF site?	See attached Berkeley Lab comment 18 provided to IFEU on September 5, 2000.
C.1 What exposures to neutron and gamma radiation resulted from LBNL operations?	Comment provided below.
C.2 What exposures resulted from past releases of tritium?	Comment provided below.
D.1 What is the potential health risk from past exposures?	Comment provided below.
D.3 What is the risk in case of accidents, such as fire?	Comment provided below.

A.1 Is the tritium inventory at NTLF adequately determined?

IFEU Conclusion and Recommendation (page 7);

The current inventory of tritium at NTLF is reported to be around 13,000 Ci. The potential error of that estimate, however, is greater than 20% and thus exceeds the reported airborne tritium releases. The inventory data thus does not allow verification of data on releases into the environment. However, for a variety of reasons, it is desirable to improve the accuracy of tritium inventory. With due consideration to limitations expressed above, the inventory data, in connection with other information such as the number of experiments in a given time period, and the amount of tritium in waste streams, will allow us to evaluate of those types of operation at the NTLF which can be regarded as typical. In order to verify the data provided by the new high precision thermoelectric calorimeter, an independent audit of the data is recommended.

Berkeley Lab Comment to IFEU Item A.1:

Berkeley Lab has purchased, and installed a high precision thermoelectric calorimeter. The system is currently being calibrated and assessed to determine its role in improving the accuracy of NTLF's tritium inventory. Preliminary investigations with the calorimeter have demonstrated that performance is within the original performance goals. The estimated precision and accuracy of measurements of tritium sources above 2500 Ci appear to be near 1% each. For smaller amounts of tritium, the precision is limited to about 25 Ci due to thermal and electronic noise inherent in the system.

In addition to these precision limitations, all sources of tritium must be able physically fit into the measurement cell, which is a cylindrical can 6" in diameter and 10" long. The measurement cell can accommodate uranium beds used for tritium storage, and the small tritium waste containers commonly used at the NTLF. The measurement of waste is limited, however, by the fact that few, if any, waste containers contain levels near 25 Ci. It may be possible to reduce the 25 Ci limit and efforts are underway to accomplish this, but in any case, it will not likely drop below about 10 Ci due to the technological limitations of the calorimeter's design. In addition to developing the technical application of the calorimeter, Berkeley Lab is also establishing procedures for calibration, operation and quality assurance of the measurements.

A.3 Is tritium in air measured at the right locations?

IFEU Conclusion and Recommendation (page 17-18);

The current number of sampling locations is below the de facto standard established at other DOE facilities. It is recommended that the number of sites that are monitored for tritium in ambient air be increased to cover at least all 16 wind direction sectors. This will ensure that accidental and diffuse releases that may bypass stack monitors would be detected. As of January 2001, LBNL has proposed to increase the number of ambient air monitoring stations to 14. This is a significant improvement over the current situation. It is noted that not all potentially

impacted sectors are covered. It would be useful if LBNL would provide a rationale for the sampling locations.

The selection of precise sampling locations should be based on a detailed evaluation of expected tritium concentrations in air using a dispersion model capable of accounting for the complex terrain and the short-term nature of tritium releases. It is obvious that in a given wind direction sector, the monitored location will not always reflect the largest offsite concentration. There is, however, an upper limit to the ratio of (maximum offsite air concentration)/(maximum monitored air concentration). This ratio can be calculated using appropriate dispersion models. It is suggested that this information be included in the annual environmental monitoring reports.

We understand that considerations are being made to remove the present tritium stack to a new location at building 75. This will likely decrease the impact on off-site locations. In addition, a contract is being arranged with U. C. Davis to perform wind tunnel modeling of the LBNL site which theoretically would provide scientific grounds for the establishment of environmental monitoring stations. We support both of these goals.

Berkeley Lab Comment to IFEU Item A.3:

The number of stations in Berkeley Lab's ambient air network and their placement has satisfied applicable regulatory compliance requirements. Since ambient air measurements are not a requirement under NESHAP, the sole requirement for the Berkeley Lab network comes from DOE orders. The official DOE criteria for siting monitoring locations are meteorology, demography, and potential dose. Berkeley Lab considers these criteria when reviewing the ambient air network each year.

Nonetheless, Berkeley Lab is moving forward with plans to significantly expand its ambient air network from seven stations to 15. Two of the eight additional sites will address an EPA supplemental sampling request and only partially satisfy the IFEU concern of detecting accidental or diffuse tritium releases when winds are blowing from infrequent directions. The remaining six sites have been strategically positioned around the tritium source to cover as many of the 16 standard wind directions (e.g., N, NNW, NW) as practical and do so in a technically sound manner. Berkeley Lab has performed CALPUFF dispersion modeling to ensure that selected monitoring locations are within the region where detectable tritium levels are expected. But regardless of the CALPUFF modeling, the selected locations are as close to the tritium source as practical in a given direction away from the source without compromising the practical aspects of conducting sampling.

In past annual site environmental reports, Berkeley Lab has included discussions involving analyses of accidental releases that occurred during the reporting year. Berkeley Lab will continue to do this in the future as such an assessment is a critical aspect of this reporting process. The report already includes a wealth of information on annual program activities, including individual and summary monitoring results, and NESHAP dose assessment results.

A.6 How relevant is the presence of organically bound tritium?

IFEU Conclusion and Recommendation (page 26)

Only a small fraction of the total airborne emissions was captured in trees around NTLF. The inventory in trees in the 200 meter radius around NTLF is estimated to be less than 1 Ci; the tritium inventory in groundwater is estimated to be less than 1 Ci as well. Even if the entire tritium inventory in trees and groundwater were to be released into the air via leaf transpiration, the source term would be equivalent to the amount of tritium emitted from NTLF during a few average days of NTLF operation. It is recommended to continue sampling and analysis of organically bound tritium (OBT) as well as tissue free water tritium (TFWT) in plant tissues. Tree ring analysis can provide valuable information about past exposures.

Berkeley Lab Comment to IFEU Item A.6: Berkeley Lab agrees with IFEU that the inventory of tritium in trees and groundwater is a small fraction of NTLF annual tritium emissions. The groundwater and vegetation data used to estimate the tritium inventory has been collected over several years. Nevertheless, Berkeley Lab is committed to collecting and analyzing additional vegetation sampled for OBT and TFWT as part of the EPA Superfund Sampling and Analysis Plan. Berkeley Lab is considering the application of tree ring analysis for obtaining more information about historical environmental tritium concentrations.

B.1 Is LBNL's Draft Tritium Sampling and Analysis Plan sufficient to determine the extent and nature of legacy contamination at NTLF?

IFEU Conclusion and Recommendation (page 32)

The Draft Tritium Sampling and Analysis Plan sampling and analysis program should be supplemented. The ambient air monitoring should be expanded to cover all 16 wind direction sectors (of 22.5° each). The selection of precise locations should be based on a detailed evaluation of expected tritium concentrations in air using a dispersion model capable to account for the complex terrain and the short-term nature of tritium releases. The HASL-300 core method for soil sampling should be used; samples to be analyzed for additional depth increments. The issue of sampling of groundwater should be resolved in coordination with the State of California Regional Water Quality Control Board.

Berkeley Lab Comment to IFEU Item B.1:

The U.S. Environmental Protection Agency has accepted Berkeley Lab's initial proposal of adding two supplemental monitoring stations to its network. The objective for expanding the network to cover all standard wind directions is different from that of EPA and will be treated separately by Berkeley Lab.

Berkeley Lab contracted with SENES Oak Ridge Inc. to evaluate the technical basis for siting additional ambient air monitoring stations for the detection of HTO releases from the National Tritium Labeling Facility (NTLF). For this evaluation, SENES used several criteria and incorporated wind tunnel testing results obtained from a University of California at Davis study. SENES estimated the annual average air HTO concentration isopleths using the terrain-sensitive CALPUFF computer code which was calibrated for the Berkeley Lab site. Based on the results of their analysis, SENES has proposed a new network of 15 ambient air monitoring stations that includes seven stations located within a distance of 300 meters from the NTLF. See the Berkeley Lab comment to IFEU concern A.3 for more details.

Regarding the application of the HASL-300 core method and the issue of groundwater sampling, Berkeley Lab references comments previously provided to IFEU on this item (comment # 15 and 17) which are attached to this response.

C.1 What exposures from neutron and gamma radiation resulted from LBNL operations?

IFEU Conclusion and Recommendation (page 38)

Neutron and gamma doses at various locations at the LBNL site boundary were substantially larger than today. Based on available data, maximum exposures have exceeded 500 mrem/yr using the historical conversion factors. Using current conversion factors for neutron doses, cumulative dose rates at the Olympus Gate station were greater than 2,000 mrem. It is recommended to estimate doses to the nearest residents including the contribution of all LBNL sources and pathways while taking uncertainties in monitoring data, conversion factors and other parameters into account. A recent paper (Heimers, 1999) presents cytogenetic data that suggests that neutron radiation may have a higher relative biological effectiveness (RBE) than is reflected in currently used radiation weighting factors. This paper and other data on the RBE of neutrons should be reviewed further.

Berkeley Lab Comment to IFEU Item C.1:

Berkeley Lab has carried out further dosimetry calculations to better understand the radiation environment at the site periphery in the late 1950's and early 1960's due to operation of the Bevatron. That work is summarized and discussed in three recent publications:

1. Thomas R. H, Smith, A. R. and Zeman, G. H. (2000). *A Reappraisal of the Reported Dose Equivalents at the Boundary of the University of California Radiation Laboratory during the early Days of Bevatron*. Lawrence Berkeley National Laboratory, Internal Report LBNL 45224, March 2000.
2. Thomas R. H, and Zeman, G. H. (2001). *Fluence to Dose Equivalent Conversion Coefficients for Evaluation of Accelerator Radiation Environments*. Lawrence Berkeley National Laboratory, Internal Report LBNL 47423 (in press).

3. R. J. Donahue, R. H. Thomas and G. H. Zeman (2001). *Simulations of the Neutron Energy-spectra at the Olympus Gate Environmental Monitoring Station due to Historical Bevatron Operations*. Lawrence Berkeley National Laboratory, Internal Report LBNL 47422 (in press).

These three reports review the techniques of evaluating neutron dose equivalent in the early 1960's and validate the data. The following list is a summary of noteworthy evaluations and results reported in these publications.

1. Provided a set of neutron fluence to dose equivalent conversion functions, which are largely based on and extend international recommendations of the ICRP and ICRU. These conversion coefficients, when applied to the historical spectra, reduce the reported dose equivalents by at least a factor of 2.
2. Independently determined, by the best available radiation transport methods, the shape of neutron differential energy spectrum at the laboratory boundary. This spectrum resolves more detail than was possible during the early '60s but confirms the methods used to evaluate dose equivalent at that time.
3. Evaluated the influence on the neutron spectrum at the laboratory boundary of shielding by the air, earth and the Bevatron magnet yoke. These studies validate the methods of the 60s.
4. Evaluate the influence of the changes in the evolution of dose equivalent quantities on neutron conversion coefficients. Although changes in the definitions of the radiation protection quantities have taken place the neutron conversion coefficients have remained nearly invariant.
5. Showed that, in addition to the factor of 2 referred to (1) above, the calibration and energy response characteristics of the neutron detectors provides a comfortably conservative determination of neutron dose equivalent (estimated to be conservatively a factor of 1.3).
6. Showed that when not in direct line of sight of the neutron sources produced by the Bevatron, dose equivalents are reduced by a factor of about 2. This result confirms earlier measurements.
7. Confirmed that dose equivalent due to Bevatron neutrons decreased as a function faster than inverse square of distance, so that doses at nearby residences were lower than that measured near the fence line.

Based on the above studies and on information provided earlier to IFEU, Berkeley Lab does not believe that any further evaluation is warranted for Bevatron radiation fields produced in the late 1950's and early 1960's.

Regarding the recent paper on neutron RBE, the observation of RBEs higher than 20 for specific biological endpoints is not new and was known to the ICRP when it made its recommendations of the radiation weighting factors, w_R , for neutrons in 1990. The ICRP continuously reviews such measurements of RBE and is fully aware of current research on this topic. Revised recommendations are anticipated soon. Informed ICRP sources do not expect any increase in the values of w_R for neutrons.

C.2 What exposures resulted from past releases of tritium?

IFEU Conclusion and Recommendation (page 40)

Reported concentrations of HTO in ambient air peaked in 1978 (2,200 pCi/m³). This value is more than a factor of 100 greater than the concentrations measured at LHS in 1999 and would exceed the current NESHAP compliance standard of 1,500 pCi/m³, though it did not exceed the then-prevailing limit. Reported concentrations at LHS and Olympus Gate were often equal to those reported for LHS while one would expect lower concentrations due to atmospheric dispersion. The reliability of historical data is limited. It depends on uncertainties in sampling and analysis and should be evaluated further. It is recommended to estimate doses to the nearest residents including the contribution of all LBNL sources and pathways while taking uncertainties in monitoring data, conversion factors and other parameters into account.

Berkeley Lab Comment to IFEU Item C.2:

Berkeley Lab agrees with the IFEU conclusion that the reliability of some earlier (i.e., until mid-1990s) ambient air data is limited because sampling instrumentation and analytical methods were less rigorous than those in place today. However, it is important to remember that the earlier monitoring program was adequate for the requirements of the time. Furthermore, Berkeley Lab does not believe that a dose reconstruction is warranted based on the historical environmental tritium data.

The NESHAP dose standard of 10 mrem per year (for air emissions) listed in 40 CFR 61, Subpart H was approved in 1989. Even in the early 1990s when tritium emissions from the NTLF centered around 100 curies per year, the maximum estimated dose from all Berkeley Lab activities using EPA-approved compliance methods was less than 2 percent of this standard. The location of this maximum is slightly more than 100 meters from where the tritium is released. The area where the nearby residential section begins is nearly 500 meters from this source and predicted dose impacts are considerably less than at the site of the maximum.

With annual emissions in the years before the NESHAP regulation never more than six times higher than the early 1990's (e.g., 500 curies in 1984 and 570 curies in 1988), the corresponding predicted dose would have been a small fraction of the NESHAP standard had that standard been in place during the years in question. Considering variabilities and uncertainties in meteorology, stack emissions, ambient samples, and analytical detection limits, estimated doses would not realistically change enough to justify a dose reconstruction effort. Similar to the monitoring program, the doses derived from the environmental measurements during years before and after the NESHAP standard went into effect have consistently been well below requirements for DOE facilities.

The environmental concentration value of 1,500 picocuries of tritium per cubic meter of air is not the appropriate NESHAP standard of comparison for Berkeley Lab. EPA has established this value as an alternative compliance measure for facilities that do not have acceptable in-stack

sampling systems that generate the inputs to the dose assessment. Berkeley Lab's stack sampling meets the requirements of NESHAP.

In response to other issues raised under this concern, Berkeley Lab acknowledges that Figure B from its earlier response inadvertently dropped a trailing zero (0) for all three sampling stations in the 1997 data. Berkeley Lab also understands the methods that are used to calculate annual averages and how they can lead to results that are below the reported detection limit. The point Berkeley Lab was attempting to emphasize in its earlier response was two-fold:

1. The state of the science for environmental sampling and analysis has improved substantially in the past decade, and
2. There was no requirement to obtain high precision environmental measurements when levels were established to be well below the regulatory standards in place at the time.

Berkeley Lab agrees that a complete understanding of the makeup of the annual averages requires an in-depth examination of the individual samples making up the average. Such an examination needs to include variable factors such as meteorology, analytical errors, and short-term releases, as well as the fact that the Berkeley Lab network has evolved from sampling durations of one week to one month. Additionally, the earlier placement of some sampling stations needs to be considered. For example, prior to 1997, station ENV-LHS was sited inside a lower level workplace office setting at the Lawrence Hall of Science. This is the primary reason why reported levels for that period often do not drop off between ENV-LHS and ENV-13D in conformance with dispersion theory. However, Berkeley Lab does not feel such a scrutiny of the earlier data is useful in this case as the results throughout the years are indicative of a program that operated well below any standards in effect at the time.

D.1 What is the potential health risk from past exposures?

IFEU Conclusion and Recommendation (page 44)

Radiation doses from past operations at LBNL were comparable to those at locations where considerable efforts were undertaken to reconstruct exposures to members of the public. In light of uncertainties regarding the magnitude and relative biological effectiveness of neutron exposures and the contribution from other radionuclides and non-radioactive pollutants, an in-depth review is recommended. A prerequisite for the risk assessment process involves dose reconstructions for past LBNL operations.

Berkeley Lab Comment to IFEU Item D.1:

As indicated above, three recent papers from Berkeley Lab have eliminated many of the uncertainties referred to by IFEU in monitoring data, conversion factors (coefficients) and other parameters.

Regarding dose reconstruction, Berkeley Lab believes that when external radiation fields from a facility do not exceed regulatory limits for the general public, dose reconstruction is not warranted. If this were not true, there would be no limit for when and where dose reconstruction efforts are needed.

D.3 What is the risk in case of accidents, such as fire?

IFEU Conclusion and Recommendation (page 47)

The adequate determination of the consequences of potential accidents at the NTLF is of particular importance to ensure that the facility is in compliance with DOE Standard 1027-92. The Safety Analysis Document concludes on page 3: “The analysis shows that full release of the tritium inventory could not cause ‘significant localized consequences’”, which are defined as accidental doses at 30 m exceeding 10 rem (which equals 10,000 mrem). The preliminary review indicates that this claim may be false. Parameters in the Safety Analysis Document were selected without assessing that the resulting doses are realistic for the whole array of potential scenarios. This is evidenced by the comparison of doses calculated in the Safety Analysis Document for the worst accident (a fire at NTLF releasing 15,000 Ci of HTO) with results from alternative calculations. While the Safety Analysis Document concludes that the maximum off-site exposure is 4.8 mrem at a distance of 1,100 meters, doses would be between 2,900 to 18,000 mrem using the “jogger scenario” from the SENES Inc. report. This assumes that the tritium is released from the stack with no plume rise from the fire; conditions which could prevail if HTO is released at the onset of a fire.

An independent evaluation of the assumptions underlying the scenarios, the calculation model and its parameters is lacking. It is therefore recommended that an independent reassessment of consequences from accidents at NTLF be performed.

Berkeley Lab Comment to IFEU Item D.3:

The following comment consists of two sections: (1) DOE facility categorization, and (2) Fire accident analysis in the NTLF SAD.

(1) DOE Facility Categorization

DOE facilities containing radioactive material are categorized as Category I, II, or III Nuclear Facilities, or radiological/low hazard facilities. Nuclear facilities have the potential for “significant consequences” to site personnel or the public. Safety Analysis is required to assess the potential hazards at Nuclear Facilities. Category III Nuclear Facilities, the lowest Nuclear Facility hazard classification, are those that have the potential for only “significant localized consequences” (could cause significant radiation doses to nearby personnel in an accident situation). Berkeley Lab does not have any Category I, II or III nuclear facilities.

Facilities that are categorized below the nuclear facility level are “Low Hazard” or “Radiological” facilities, not capable of causing significant dose consequences. These facilities do not require formal hazard analysis.

The criteria for facility categorization are specified in DOE STD 1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*. This DOE standard lists radioisotope inventory thresholds that allow preliminary categorization. Once preliminarily categorized as a Nuclear Facility, a Safety Analysis Report is prepared that analyses hazards in a detailed manner and allows final categorization. This report and the final facility categorization must be approved by DOE.

The Category III inventory thresholds in DOE STD 1027-92 are based upon an EPA dose calculation model that was used to calculate reportable radioisotope releases specified by an EPA regulation. The thresholds are the amounts of radioisotopes, which if released according to the model, would result in a dose of 10 rem to an individual at 30 meters from the release. In the case of tritium, however, this model was not used to calculate the threshold. The Category III inventory threshold was arbitrarily set at 1000 Curies, only 1/16 of the value that would be derived by the model.

In 1997, DOE STD 1027-92 was revised and the tritium Category III inventory threshold was changed to 16,000 Curies, in line with the model. Note that the inventory limit at NTLF is below the new threshold. Thus NTLF is categorized as a Low Hazard or Radiological (not Nuclear) facility.

(2) Fire Accident Analysis in SAD

The following fire accident analysis is contained in the current SAD for the NTLF. The SAD was externally reviewed and approved by the Headquarters of the DOE.

The most credible release scenario for complete release of HT gas from a full uranium bed (15000 Curies) and complete oxidation to HTO (much more hazardous than HT) is a fire.

The HT will release from the bed at 300 degrees C, but would stay in the closed steel system. At 600 degrees C (very hot fire) the steel system becomes permeable, the HT releases to the room and oxidizes to HTO in the fire. A fire that would continue long enough to release the tritium is extremely unlikely, (low combustible loading in the room, sprinklers, Berkeley Lab Fire Department 5 minute response, etc.)

It was assessed that such a hot fire (that would compromise the sprinkler system) would also overwhelm and disable the ventilation system. The fire, whether started internal or external to the lab, would cause effluents to exit directly from the building.

HOTSPOT is an LLNL-developed computer code designed to model dispersion of radionuclides during a fire. Input parameters were 15,000 Curies H-3, 20 million BTU fire loading, exit from the facility. The burn time was 160 minutes. It was assumed that a receptor would be in the maximally exposed location during the whole time of the release.

HOTSPOT gave the following results: a 38-meter plume height above Building 75 and a maximum dose of 4.8 millirem downwind. This assumption is conservative because a small building fire would result in a lower, more concentrated plume than a wildland fire.

IFEU was concerned that the fire could start out small and the tritium inventory could be released through the ventilation stack, thus causing higher offsite doses. In the SAD, Berkeley Lab determined that it was not credible that the entire tritium inventory would be released via the ventilation system through the stack. This analysis was thoroughly reviewed and approved by DOE, and served as the basis for DOE classification of NTLF as a non-nuclear facility.

The tritium cannot be released from the closed stainless steel system (valves and traps) or oxidized to its more toxic form, HTO, until temperatures reach 600 degrees C. A small fire that heats up the tritium storage bed would not release tritium out of the stack due to the closed valves in the system. The storage bed system is designed to hold pressure and even at 600 degrees C the HT would only be released slowly. If the sprinkler system in the room is somehow rendered ineffective and the fire continues to burn, then it would be possible for the tritium to be released. Once the fire causes the system to reach 600 degrees C the steel system becomes permeable to tritium and the tritium is released and oxidized. It is not credible that the ventilation system would be operable under these conditions, or able to remove the tritium and other combustion products from the room via the stack. The fire plume would therefore exit the building, as modeled in the SAD.

Dr. Owen Hoffman (SENES) also agreed with this analysis. He has stated that the assumptions used in their modeling (15 minute puff release, ideal meteorological conditions) would not apply to a building fire situation.

As part of the Berkeley Lab project to relocate the NTLF Hillside Stack later this year, an independent fire accident analysis and dose assessment will be performed by an external contractor.